nuclear cells, and a diminished lymphocyte count. In the present case this postoperative leukocytosis was a marked feature, reaching 87,000, with 98 per cent. of polynuclear cells on the second day after operation, and then gradually falling, but not back to normal.

It has previously been suggested that the tuberculosis of the spleen, in view of the autopsy findings, might be the simplest explanation for the polycythemia on the basis that the diseased spleen failed to destroy the red corpuscles. Other case reports of polycythemia, however, show numerous examples of the disease in which the spleen while enlarged was not tuberculous, and in twenty-six of the cases of tuberculosis of the spleen where the blood count was reported, collected by Winternitz, polycythemia was present only in six. Also, the condition of the bone-marrow in this and in other cases, and the blood-picture after splenectomy, would seem to indicate as a more logical presumption, that whatever may be its cause, the polycythemia, and in this case it was a polycythemia and not an erythrocythemia alone, had its direct pathological factor in the overproduction or overfunctionating of the bone-marrow. If this presumption is correct, then we can explain the enlargement of the spleen as an hypertrophy due to an effort to destroy the over-production of red cells. Finally, if there is a focus of tuberculosis elsewhere in the body from which the tubercle bacilli might enter the blood-stream, it would find in the spleen a place of diminished resistance. Thus, rather than as an etiological factor, the tuberculous spleen would be a result of the polycythemia.

Finally, while we may agree with Winternitz that in cases of tuberculosis of the spleen, when other tuberculous foci are not demonstrable, splenectomy may effect a cure; although our case proves nothing, it does add some evidence to the statement of Osler that splenectomy is contraindicated in erythrocythemia, and that when the two conditions coexist operative procedure can be of no value.

GIANT TUMORS OF THE CONUS AND CAUDA EQUINA.[1]

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Tumors of the cauda equina and of the conus cause symptoms which are considered fairly pathognomic. Nevertheless, the lesion is usually, at one time or another, mistaken for some other disease, and, on the other hand, patients are submitted to operation for tumor of the cauda or conus, and some other affection or no gross changes may be found. Then, again, the results of operation for tumor of this region, leaving aside the nature of the tumor, are by no means uniform. It is difficult for a neurologist to say to a patient with symptoms of cauda or conus tumor what will be the certain result of the operation advised. All this makes it imperative that the details of every case encountered should be published.

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[1] Read at the meeting of the American Neurological Association, Washington, May 5, 1913.

The tumors that we shall describe, probably originate from the pia over the roots or from the roots of the cauda equina themselves; they grow slowly, causing a few symptoms until they have attained a large size. Finally, when the symptoms are well-marked, the tumors fill the entire lower part of the spinal canal, surrounding the roots of the cauda equina and extending upward upon the conus and lumbosacral cord.

Case I.--A male, aged forty-two years, Russian Hebrew, married, peddler. Complaints: Difficulty in walking, weakness and stiffness in the lower extremities. Pain in the centre of the small of the back radiating into the hips; inability to have full control of the vesical sphincter; irregular twitching of the right thigh, which always precedes expulsion of urine.

Duration of the symptoms was nine months, and the initial symptom pain, continuous, made worse by standing or walking, and relieved somewhat by lying down. Course of the disease steadily progressive. No history of syphilis.

On close inquiry, after the patient came into the hospital, an interesting story was obtained from him: which was that nine years before, while walking on a railway, he fell and struck his back. He was laid up for a fortnight. About one year afterward, that is, eight years before coming to us, he began to complain of pain in the lumbar region and in the posterior surface of the right thigh. This pain lasted for about eight or nine months, and he went to a hospital in New York City and stayed there for several weeks. Off and on since then he has had some pain in the back and in the thigh. Two years ago he had a severe attack and he justifies himself in stating that the beginning of his present illness was nine months before, by the fact that he was able to work until that time.

Physical Examination. Nutrition: No observable change. Motion: Station feeble, scarcely able to stand securely. Gait: jerky and spastic movement of the right foot in walking, the left normal. Paralysis: Right leg was weaker than the left. Mechanical restriction: No limitation of motion in the lower extremities. Marked rigidity of the lumbar spine. Reflexes: Right knee-jerk absent, left barely elicitable on reinforcement; both ankle-jerks absent; plantar jerks not elicitable; upper abdominals and epigastric reflexes lively; lower abdominals and cremasterics could not be elicited; upper extremities normal. Disturbances of sensation illustrated by accompanying chart (Fig. 1); laboratory examinations were negative.

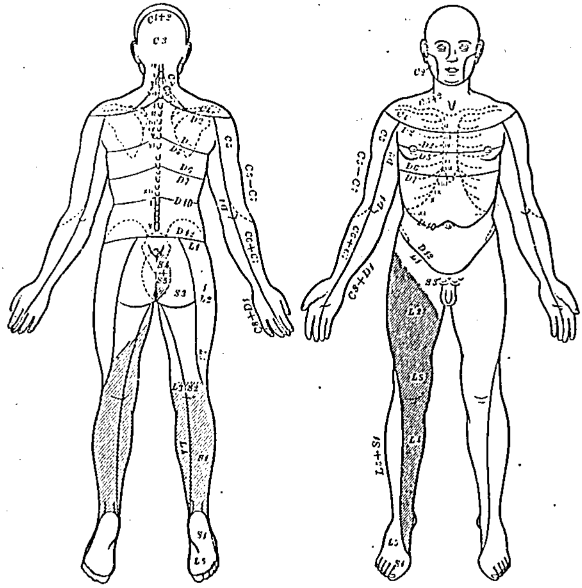

FIG. 1.—Case I. Nathan S., sensory disturbance for touch, pain, and temperature. Close shading, moderate diminution; coarse shading, very slight diminution in sensation.

Surgical History. January 27, 1910: Laminectomy (Dr. Elsberg). The spinous processes and laminæ of the twelfth dorsal and first, second, and third lumbar vertebræ were removed. The exposed dura was of a bluish color on account of a tumor mass beneath it. After incision of the dura a large brownish growth (Fig. 2, I) was exposed, which enveloped the roots of the cauda equina and extended up on the conus. Above the tumor was well encapsulated and could be freed without difficulty; below it was impossible to separate it from several of the nerve roots without dividing them. The growth filled up the lower part of the spinal canal, and below, small fragments of tumor tissue were undoubtedly left behind. Suture of dura, muscles, fascia, and skin.

The tumor measured 2 by 5 cm., and weighed 14 grams; it was soft and not very vascular. It was an endothelial sarcoma. The patient recovered from the operation, and the wound healed by primary union. After a few weeks he began to look badly, the urine became loaded with albumin, casts, and pus. Four weeks after the operation he was markedly anemic. On February 29, five weeks after the operation, he died in a convulsive attack. No autopsy permitted.

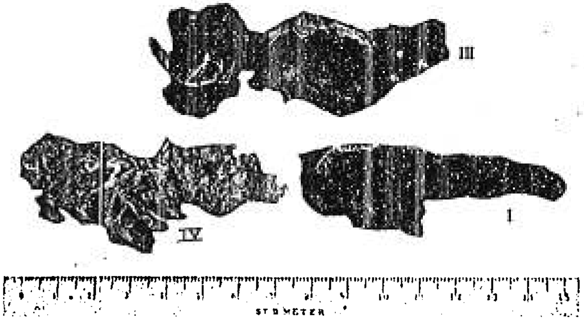

FIG. 2.—Giant tumor of the cauda equina removed at operation.

CASE II.—Woman, Russian Hebrew, aged twenty-five years; married. Complaints: Pain in the back radiating down the legs, more severe in the left than in the right leg; weakness in the lower extremities; difficulty in passing urine. Duration of symptoms had been about two and a half years, initial symptom being the pain. This pain began about a fortnight after she married, gradually increased in severity, and since the birth of a child, ten months after marriage, it had grown worse rapidly. Pain increased by any attempt at movement, such as walking or going up and down stairs, and was least when lying down.

She had been subjected to many kinds of treatment. Had worn arches for double flat-foot; had been in a plaster jacket for alleged spinal trouble, etc.

Physical Examination. Nutrition: Nothing noteworthy save a faint systolic murmur at the apex, hemic in character. Station: Weak and uncertain. Gait: Shuffling, "rooster" gait. Paralysis: Drop-foot on both sides. Marked stiffness of the lumbar spine. Reflexes: Knee-jerks faintly elicitable; ankle-jerks present; plantar flexion; abdominal and epigastric reflexes present. Sensation: As indicated on the chart (Fig. 3).

It is noteworthy that percussion on top of the head caused intense pain in the lumbar spine, and that the lumbar vertebræ themselves were tender on percussion.

Laboratory examinations were all negative, save that the lumbar puncture brought forth a dark yellow fluid which contained no cells, gave a negative Wassermann, and coagulated solid on application of heat.

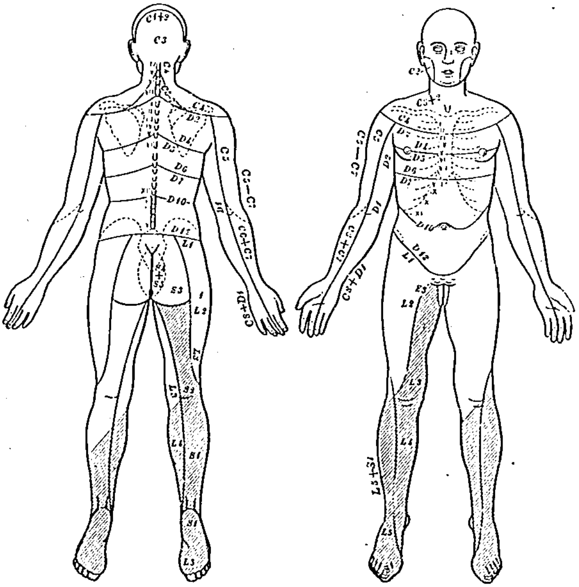

FIG. 3.—Case II. Mrs. P., very slight disturbance of touch, pain, and temperature over shaded areas.

Surgical History. December 3, 1910: Laminectomy (Dr. Elsberg). Removal of spinous processes and laminæ of the third, fourth, and fifth lumbar vertebræ, later of the second and first lumbar and the twelfth and eleventh dorsal vertebræ. The exposed dura was of a bluish color, and did not pulsate. There was evidently a large neoplasm within the dural sac. The dura was incised, exposing a large reddish-brown tumor mass, which surrounded the roots of the cauda equina and filled up the entire spinal canal to the lowermost part exposed. Above it was necessary to remove the eleventh and twelfth dorsal and first and second lumbar arches, and to incise the dura upward, before the upper end of the tumor was exposed. The growth extended upward upon the conus and lumbosacral cord, and was well-limited and but slightly adherent to the cord. During the various manipulations the tumor gradually bulged out of the canal until it seemed about three times as thick as when first exposed. Below could be seen some roots of the cauda equina surrounded by tumor tissue. It was deemed advisable to delay the removal of the growth in order to allow the tumor to be extruded from the canal. The wound was therefore closed without drainage.

December 10. The wound was reopened and the tumor was found markedly extruded. With little difficulty the growth was freed from the conus and from the inner surface of the dura, which was everywhere smooth and glistening. The growth was likewise easily freed from the roots of the cauda, although it was firmly adherent to the filum terminale. Several fragments of tumor tissue had to be separately removed with a sharp spoon. The wound was closed in the usual manner.

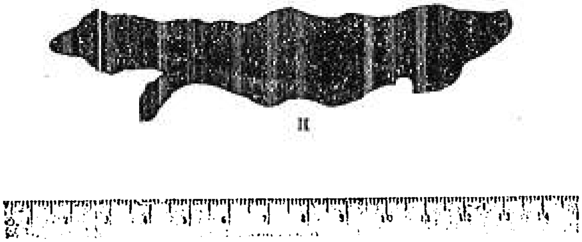

FIG. 4.—Giant tumor of the cauda equina and conus removed from Mrs. P.

The tumor removed (Fig. 4) measured 14 cm. in length and 6 cm. in circumference in its widest part, and was reported by the pathologist as endothelial sarcoma. Convalescence from operation uncomplicated.

December 17. Slight flexion and extension at the knees was possible.

January 6, 1911. Power in the right lower extremity was better than in the left, flexion at thigh and hip—about 75 per cent. of the normal on the right, about 30 per cent. of the normal on the left.

January 20: Discharged from the hospital. Patient had gained much flesh and strength; could stand on her feet when aided; was able to extend and flex both legs with ease; knee- and ankle-jerks were still absent.

September 6: Patient continued to gain flesh and strength. Could walk, but had trouble on account of the persistent foot-drop. Knee- and ankle-jerks were still absent. Patient was free from pain; no disturbance of sensation could be found.

CASE III.—Male, Russian Hebrew, aged thirty years, married, painter. Complaints: Pain starting in the middle of the small of the back and extending down both thighs and legs; weakness of the lower extremities so that walking was difficult; inability to pass urine; impotence.

The initial symptom was pain in the middle of the back, which was not continuous in the beginning. It was made worse by exercise, and was relieved by hot applications and a hot bath. His first incapacity was in bending over and in straightening up after he bent over. After the pain had existed in one lower extremity for about three months it appeared in the other. At this time he was seen by a number of neurologists and was treated as a case of sciatica. His symptoms had been in existence for about two years when we first saw him. Course of symptoms had been steadily progressive.

Physical Examination. Nutrition: The skin of the feet was soft and shiny, the nails strikingly convex, with transverse markings. Motion: When the feet were lifted from the ground there was distinct drop-foot on both sides. Gait: Typical "rooster" gait. Station: He stood fairly securely when his feet were together when the eyes were open, but swayed when the eyes were closed.

There was no muscular atrophy. Reflexes: knee- and ankle-jerks absent. Plantar reflex was flexor in type; abdominal and epigastric reflexes were lively; cremasteric reflexes could not be elicited. There was a diminished response to the faradic current in the peroneal muscles, more marked on the right side. There was distinct stiffness in the lumbar vertebral column, and the lower lumbar spines were sensitive to pressure and percussion. The sensory disturbances are indicated in Fig. 5. There was a distinct area of exquisite hyperesthesia at the upper border of the sacrum. On doing a lumbar puncture, the needle, after entering the cavity, gave the operator's hand a sensation of there being some friable substance encountered, and the patient complained of a burning sensation transmitted down the right hip and leg. No fluid was obtained.

Surgical History. October 4, 1911. Laminectomy (Dr. Elsberg). Removal of the spines and laminæ of the first, second, third, and fourth lumbar vertebræ and later of the eleventh and twelfth dorsal. Shining through the dura, which was very thin, was a reddish-brown tumor mass, over which were spread the roots of the cauda. Incision of the dura revealed a large tumor, which filled the spinal canal from the sacrum below to the conus above. The actual removal of the growth was left to a later stage, so as to allow of the extrusion of the growth.

The tumor was removed one week later; above, it was well limited and easily freed from the conus; below it surrounded the roots of the cauda and not all of the tumor could be removed. In spite of

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careful dissection, small fragments of tumor tissue had to be left behind. Bleeding was moderate; closure of the wound in the usual manner.

The tumor was 10 cm. long (Fig. 2, III), and was reported as being an endothelioma.

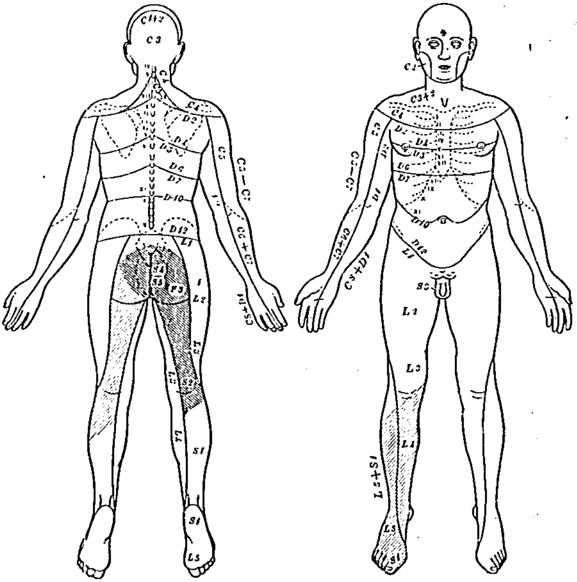

Fig. 5.—Case III. J. S., sensory disturbances for touch, pain, and temperature. (Shading the same as in Case. I.)

Convalescence was uneventful. Two weeks after the operation the patient was able to urinate voluntarily, and the pain in his back and limbs was somewhat less. He was discharged from the hospital three weeks after the operation. Two months later, sexual power had returned, but the patient complained much of a stiff feeling in his legs and of frequency of urination.

March 1, Patient had been receiving injections of Coley's fluid and *x*-ray treatment twice each week. Still complained of stiffness in his legs and frequency of urination; knee- and ankle-jerks were still absent. No longer had foot-drop; sensory disturbance unchanged.

January 22, 1912. The patient was last examined on this date. His complaints were: Pain in the back and right thigh; feeling of stiffness; obstinate constipation; no feeling when his bowels moved; weakness of the legs; incontinence of urine.

He stood securely, with his back not stiff, walked with a stick, with a slightly shuffling gait. The tendon-jerks of the lower extremities were absent, and the only striking difference from his condition before the operation was in the objective sensory disturbance and the disappearances of the foot-drop.

Each of these three patients presented a clinical picture and physical signs so similar to the others that a diagnosis of the similar nature of the disease could be made. In Case I the diagnosis was suspected; in the two succeeding patients the diagnosis of giant tumor of the cauda equina endothelioma or endothelial sarcoma was made before the operative interference.[2]

The important features of the clinical histories in our patients were the following:

1. A history of two or more years' duration.
2. Pain in the small of the back, sooner or later extending down one and then the other extremity.
3. Stiffness of the back in the lumbar region.
4. Increasing stiffness and weakness of the lower extremities, with loss of power of dorsal flexion of the foot.
5. Slight disturbances of the bladder and rectum.
6. The patients were treated for sciatica for long periods.

The important features of the clinical examination were the following:

1. Rigidity of the lumbar vertebral column.
2. Weakness and stiffness of the lower limbs.
3. Paralysis of the peroneal groups of muscles and sometimes of the tibialis anticus group.
4. Drop-foot on one or both sides.
5. Absence of knee- and ankle-jerks.
6. Tenderness of the lower lumbar spines.
7. Irregular and unsymmetrical sensory disturbances.
8. Lumbar puncture was negative, or yellow fluid which was not cerebrospinal fluid was withdrawn.
9. Wassermann test and *x*-ray negative.

The typical findings at operation consisted of a large reddish-brown, not vascular, tumor within the dura, which filled up the entire lower part of the spinal canal, surrounded the roots of the cauda equina, and extended upward on to the conus, with which it was not closely connected. The growth was not intimately connected with the inner surface of the dura, and could be easily freed from it, after which the inner surface of the dura mater was found to be smooth and glistening. The growths were well encapsulated above, but were closely connected with the nerve roots below.

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[2] One of us has operated upon two additional patients. One patient was on the service of Dr. Bailey at the Neurological Institute, the other was a private patient referred by Dr. W. M. Lesynsky, of New York.

The typical history and findings in these patients were similar to the so-called syndrome of epiconus lesions described by Minor of Moscow, which may be outlined as follows: The patient begins to complain of pain and stiffness in the back, extending down the posterior aspect of one and then of the other thigh. The pain is intermittent at first, later it is continuous. After the expiration of one year or more the symptoms become worse, one or double drop-foot appears, the lower limbs become weaker and stiffer, and knee- and ankle-jerks disappear. Then follow difficulties in the functions of the bladder and rectum, irregular sensory loss, rigidity of the lumbar vertebral column, and tenderness of the lumbar spines. Peroneal palsies are regularly found, with electrical changes. By lumbar puncture no fluid is obtained, because the entire lower part of the spinal canal is filled by the tumor mass, although yellow fluid in small quantity may be withdrawn from the tumor. The patients are often suspected of tabes, and usually have been treated for long periods for sciatica.

PECULIAR FEATURES OF THE TUMORS, AND REMARKS. We are fully cognizant of the fact that, in a general way, the symptoms and signs we have outlined are those generally described as characteristic of lesions of the cauda equina and conus. But they have been combined in a peculiarly characteristic manner in our cases.

The late appearance of bladder and rectal disturbances in the patients lends support to the view of Spiller[3] and of van Gehuchten as against that of Müller[4] that bladder and rectal symptoms need not appear early in intradural pressure upon the roots of the cauda equina.

Another peculiar feature in these patients was the relatively small evidence of sensory disturbances. According to some authors (Laquer, Kummel Schmoll), sensory symptoms, in lesions of the cauda equina and conus, may be absent for years. Müller claims that in the lower end of the cord the sensory roots are larger than the motor roots, but he agrees with Klineberger that the sensory elements have a marked resisting power. It is difficult to understand why there is not a greater sensory loss in these patients, with large tumors which fill up the entire lower part of the spinal canal. The typical anesthesia in the perineum, genitals, and around the anus was usually incomplete, ill-marked, or absent. This was the more surprising as at operation the tumor was usually found to surround the roots of the cauda—those centrally situated as well as those on the outside. That these large tumors were under con-

[3] AMER. JOUR. MED. SCI., 1903, xxxv, 308.

[4] Deutsch. Zeit. f. Nervenheilkunde, 1899, xiv

siderable pressure was proved by the fact that as soon as the dura was opened they bulged markedly out of the canal.

The tumors were relatively benign in their course, they had no tendency to perforate the dura or to invade the surrounding bony structures. In this respect they differed from many of the cases of diffuse intradural sarcoma in the literature (Schultze,[5] Spiller,[6] etc.) and were like those reported by Selberg[7], Warrington,[8] Klineberger,[9] etc.

The results of the operative interference were not satisfactory, although there was considerable improvement in two of our patients. It was impossible to remove the growths entirely, although most of it could be removed if the operation be divided into two stages so that the tumor be allowed to extrude from the spinal canal in the manner described. In the one patient who received injections of Coley's fluid and x-ray treatment, not much was gained thereby. While the danger from the operative interference was small, our only hope for radical removal lay in our ability to recognize the existence of the tumor early and to refer the patient to the surgeon early. If the patients had been operated upon before the tumors had attained such large size, radical removal might have been possible.

SOME CASES OF HYPOTENSION ASSOCIATED WITH A DEFINITE SYMPTOMATOLOGY.

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It is difficult to state just how low the systolic pressure may fall and yet be considered normal. In an individual who has been observed over a period of time and in whom one has determined a uniform pressure, any deviation from this standard may with justification be regarded as abnormal if not pathological. But for the rank and file of individuals it must remain a purely arbitrary judgment at what figure to place the lower limit of normal pressure, and the standard thus erected must be regarded as but an individual opinion; nothing more.

Janeway draws the line between normal and subnormal systolic pressure at 100 mm. Hg. (R.R. 5 cm.) and 90 mm. (12 cm., G.).

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[5] Mittheil. a. d. Grenzgebieten, 1903.

[6] Amer. Jour. Med. Sci., 1908, cxxxv.

[7] Beiträge z. klin. Chir., 1904, xliii, 197.

[8] Lancet, 1905, ii, 749.

[9] Monatsschr. f. Psych. u. Neurol., 1908.